Aptamer displacement Lateral Flow assay for Phenylketonuria monitoring.

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Abstract

Phenylketonuria (PKU) is a hereditary autosomic-recessive metabolic disease that inhibits the metabolism of the amino acid phenylalanine, and it has been diagnosed after birth through bacterial inhibition assay, a well-established screening method for newborn babies since 1963.[1] Its accumulation in blood, urine, and other tissues, can cause seizures, intellectual disabilities, and other mental disorders if not adequately assessed through diet and periodic visits to an assigned PKU clinic.[2] Fast, robust, sensitive, and user-friendly tests are desirable for better monitoring of phenylalanine levels in PKU patients to improve their lifestyles. Herein, we present a Point-of-Care aptamer lateral flow biosensor in a strand displacement format and gold nanoparticles (AuNPs) as an optical label for phenylalanine determination in a buffer sample, allowing the determination of mild hyperphenylalaninemia, mild PKU, and classic PKU. In this work, we conjugated AuNPs to a short nucleic acid sequence complementary to a region of a previously reported aptamer that recognizes phenylalanine and printed the complex as a first line.[3] When a buffer sample containing phenylalanine reaches the aptamer, the competition displaces the AuNP conjugate and the decrease of the optical signal in the first line is measured. As the AuNP conjugate flows through the lateral flow strip, they are captured by a complementary sequence in a second line, causing the appearance of a second measurable signal. The assay is completed in 20 minutes and has a limit of detection of 50 µM, which is the standard phenylalanine concentration in healthy patients' blood.

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